# *California Geothermal Resource*

***Resource Workshop***
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# *Strategic Value Analyses (SVA) to Date*

- ***Identify, quantify and map electricity system needs out through 2017 (capacity, reliability, transmission)***
  - ***Selected years (2003, 2005, 2007, 2010 & 2017)***
- ***Identify and map out geothermal resources***
  - ***Wind, solar, biomass and water (hydro & ocean)***
- ***Project environmental, cost and generation performance of renewable technologies through 2017***
  - ***Projections developed by PIER Renewable staff; corroborated by work done by EPRI, NREL and Navigant***
- ***Conduct combined GIS and economic analyses to obtain "best-fit, least-cost" approach***
- ***Develop RD&D targets that help drive forward renewables capable of achieving identified benefits***


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# *SVA Geothermal Approach*

- ***Identification and Qualification of Resource***
- ***Calculation of the Cost of Geothermal Electricity Generation***
- ***Addition of New Geothermal Resource to the Grid***


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# *SVA Geothermal Team*

- ***CEC Staff***
- ***GeothermEx, Inc.***
- ***McNeil Technologies***
- ***Davis Power Consultants, Anthony Engineering, and PowerWorld***


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# *Mapping CA's Geothermal Resources*

- *Identify the types and amounts of Geothermal that can help resolve "hot spots"*
- *Existing data not readily useful*
  - *Not transferable to GIS*
- *Geothermal resource assessment-identifies and quantifies resource*
- *Data transferred into GIS format*


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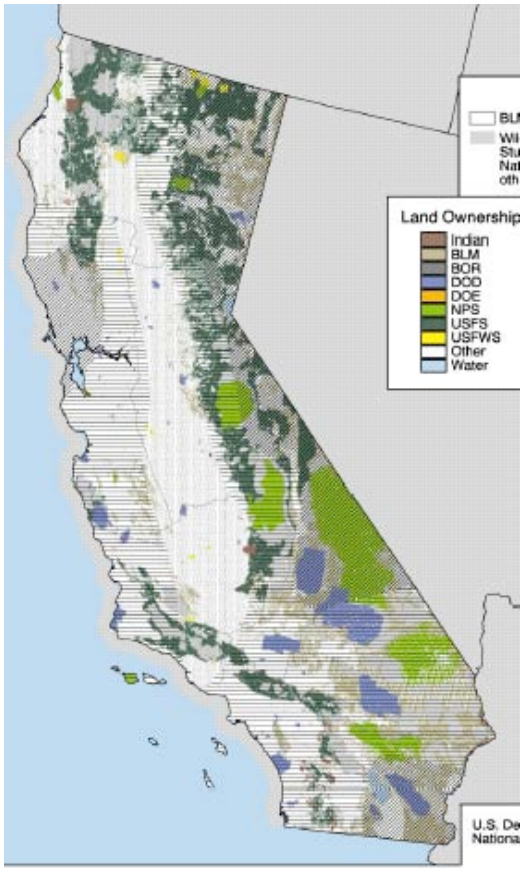
# *Visual Comparison of Gross vs Technical Geothermal Potentials*





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# *Identification and Qualification of Geothermal*

- ***Resources Assessment by GeothermEx, Inc.***


# *Scope of Work*

- ***Two main components:***
  - ***Geothermal reserves***
  - ***Estimates of capital costs***


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# *Project Maturity*

- ***Challenge has been to objectively assess and compare resources at different stages of development***

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# *Exploration – Development Categories*

- ✌ *Existing power plant is operating*
- 👌 *No operating plant, but at least 1 well with tested capacity of 1 MW or more*
- 👍 *No well tested at 1 MW or more, but downhole temperature of at least 212°F*
- 👎 *Not meeting A, B, or C: resource properties from other sources (geology, geochemistry, geophysics)*


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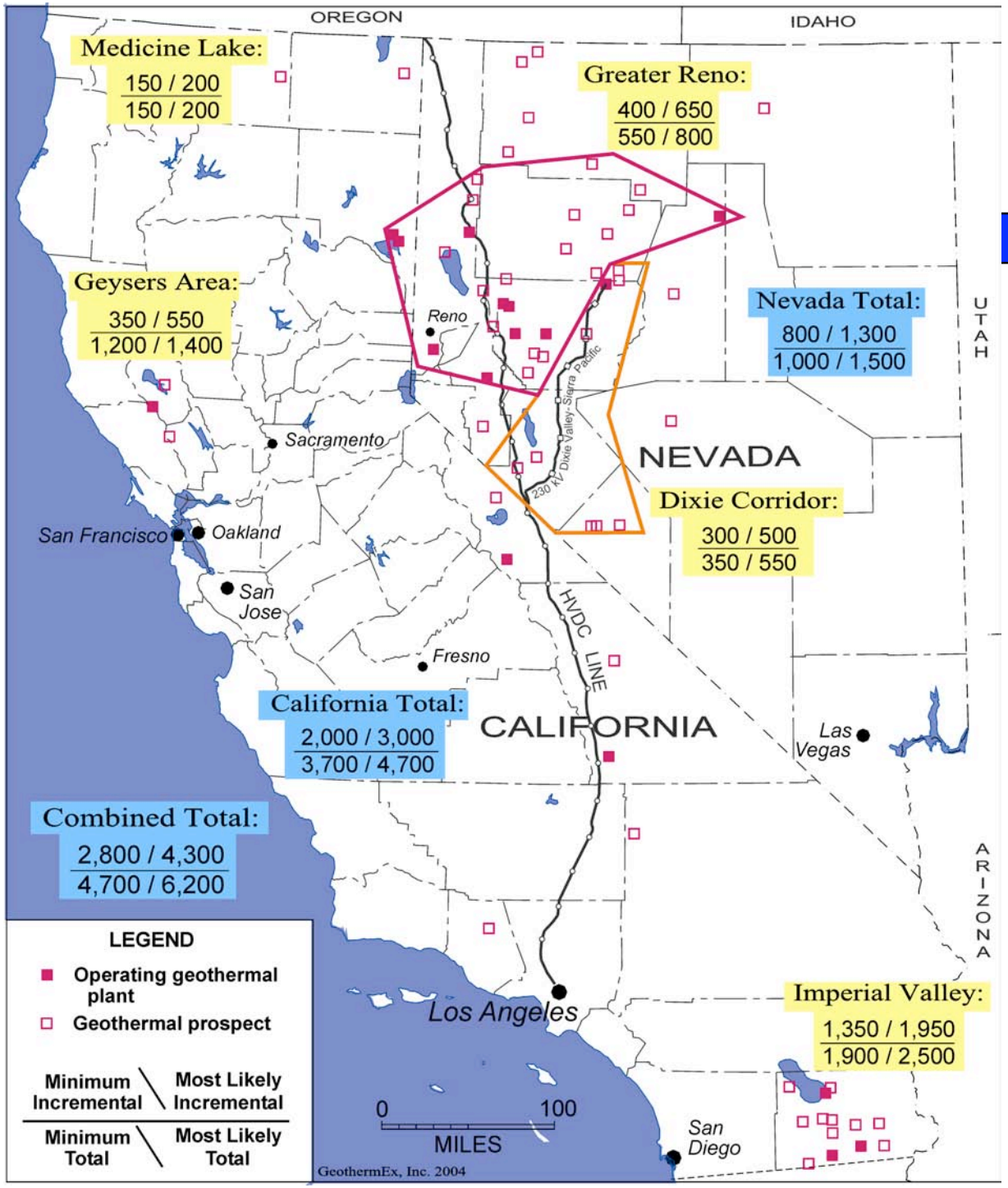


***Generation Capacities of Major Geothermal Resource Areas in California and Nevada (Gross MW)***

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## *Generation Capacities of Major Geothermal Resource Areas in California (Gross MW)*

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# *Calculation of Reserves*

*SUMMARY OF INPUT PARAMETERS*

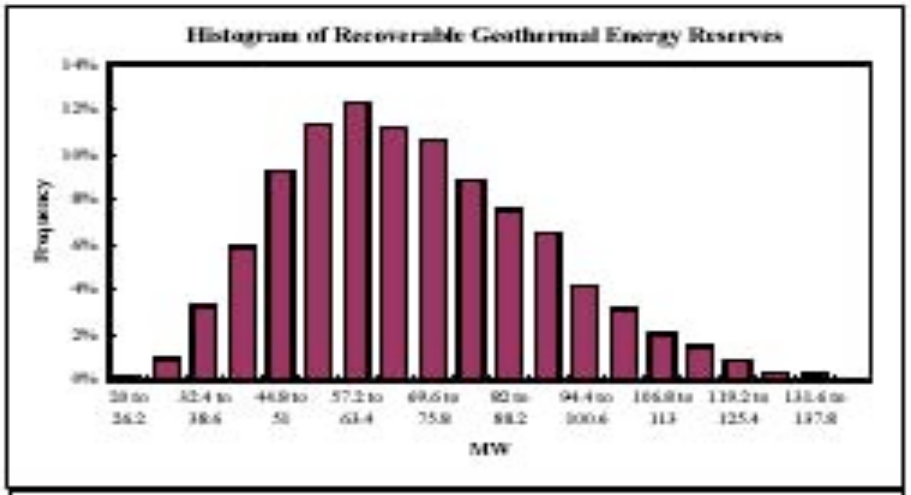
| Variable Parameters | Minimum | Most Likely | Maximum |
|---|---|---|---|
| Reservoir Area (sq. mi.) | 0.9 | 1.8 | 2.7 |
| Reservoir Thickness (ft) | 3000 | 3500 | 4000 |
| Rock Porosity | 0.1 | | 0.2 |
| Reservoir Temperature (°F) | 480 | 500 | 520 |
| Recovery Factor | 0.10 | | 0.20 |

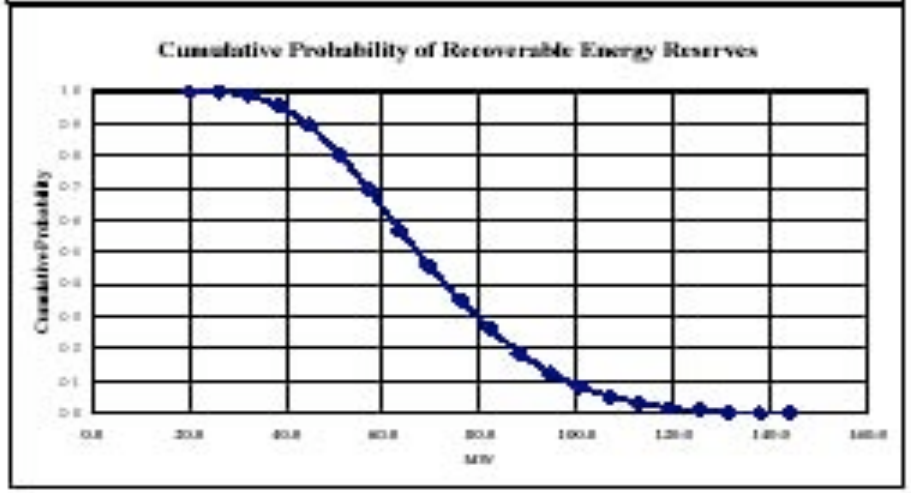
| Fixed Parameters | | |
|---|---|---|
| Rock Volumetric Heat Capacity | 39.0 | BTU/cu. ft°F |
| Rejection Temperature | 75 | °F |
| Utilization Factor | 0.45 | |
| Plant Capacity Factor | 0.90 | |
| Power Plant Life | 30 | years |

*RESULTS*

| Statistics | MW | MW/sq. mi. | Recovery Efficiency |
|---|---|---|---|
| Mean | 69.54 | 38.57 | 1.78% |
| Std. Deviation | 20.56 | 7.00 | 0.54% |
| **Minimum (90% prob.)** | **44.60** | 28.04 | 1.31% |
| **Most-likely (Modal)** | **62.20** | 34.00 | 1.32% |

**Figure BRW03-3:**
**Probabilistic Calculation of Geothermal Energy Reserves**
**SOUTH BRAWLEY GEOTHERMAL AREA, CALIFORNIA**



# *Most-Likely Geothermal Resource Capacity*

| Geothermal Resource Area | County | MLK MW | Existing Gross MW | MLK-Existing MW |
|---|---|---|---|---|
| Brawley (North) | Imperial | 135 | 0 | 135 |
| Brawley (East) | Imperial | 129 | 0 | 129 |
| Brawley (South) | Imperial | 62 | 0 | 62 |
| Dunes | Imperial | 11 | 0 | 11 |
| East Mesa | Imperial | 148 | 73.2 | 74.8 |
| Glamis | Imperial | 6.4 | 0 | 6.4 |
| Heber | Imperial | 142 | 100 | 42 |
| Mount Signal | Imperial | 19 | 0 | 19 |
| Niland | Imperial | 76 | 0 | 76 |
| Salton Sea (including Westmoreland) | Imperial | 1750 | 350 | 1400 |
| Superstition Mountain | Imperial | 9.5 | 0 | 9.5 |
| | Imperial Total: | 2487.9 | 523.2 | 1964.7 |
| | | | | |
| Coso Hot Springs | Inyo | 355 | 300 | 55 |
| | | | | |
| Sulfur Bank Field, Clear Lake Area | Lake | 43 | 0 | 43 |
| Geysers [Lake & Sonoma Counties] | Sonoma | 1400 | 1000 | 400 |
| Calistoga | Napa | 25 | 0 | 25 |
| | The Geysers Total: | 1468 | 1000 | 468 |
| | | | | |
| Honey Lake (Wendel-Amedee) | Lassen | 8.3 | 6.4 | 1.9 |
| Lake City/ Surprise Valley | Modoc | 37 | 0 | 37 |
| Long Valley (mono- Long Valley) Mammoth Pacific Plants | Mono | 111 | 40 | 71 |
| Randsburg | San Bernardino/ Kern | 48 | 0 | 48 |
| Medicine Lake (Fourmile Hill) | Siskiyou | 36 | 0 | 36 |
| Medicine Lake (Telephone Flat) | Siskiyou | 175 | 0 | 175 |
| Sespe Hot Springs | Ventura | 5.3 | 0 | 5.3 |
| | | | | |
| **Total:** | | **4732** | **1870** | **2862** |


# *Summary*

- *Technical Reserves (Gross MW)*
  - *Estimated Most Likely In California: 4,700 MW*
  - *Estimated Incremental In California: 3,000 MW*
- *Filtering Constraints*
  - *Economics*
  - *Transmission*


# *Contact Information*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